Storing, Using and Handling Compressed Gases

MSC-RD-11198

Revision 3

Effective Date: November 12, 2014

Topic: Worker Protection

Storing, Using and Handling Compressed Gases

CHANGE SUMMARY

Revision 3

Description of Changes:

1. Added a new section to deal with Propane container safety and Bulk Propane system requirements at outlined by NFPA 58 and State of Washington Code.
2. Added a new section to deal with Cryogenic Fluids to include requirements from NFPA 55 section 8.0 and WAC Code for bulk storage.

1.0 PURPOSE

This Level 2 Requirements Document provides requirements for storing, handling, and using DOT compressed gas cylinders related to Mission Support Contract (MSC) scope of work.

This document also contains a detailed scope section identifying information sources related to compressed gas operations, whether or not they are related to or excluded from the scope of this document.

This document also supports the implementation of the Integrated Safety Management System (ISMS) Core Function 2: *Indentify and Analyze the Hazards*, Core Function 3: *Develop and Implement Hazard and Environmental Controls*, Guiding Principle 2: *Clear Roles and Responsibilities*, Guiding Principle 5: *Identification of Safety and Environmental Standards and Requirements*, and Guiding Principle 6: *Hazard Controls Tailored to Work Being Performed*.

2.0 SCOPE

2.1 General Cylinders – 29 CFR 1910, Subpart H

The scope of this requirements document is primarily based on OSHA 29 CFR 1910, Subpart H – *Hazardous Materials*, but ***only*** the following sections:

- 1910.101, Compressed gases general requirements
- 29 CFR 1910.6 incorporates Compressed Gas Association (CGA) Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*, as applicable to 1910.101.

NOTE: *Only the mandatory provisions (i.e., provisions containing the word "shall" or other mandatory language) of standards incorporated by reference are adopted as standards under the Occupational Safety and Health Act (OSHA). [See 1910.6(a)(1)].*

- 1910.102 - Acetylene
- 1910.103 - Hydrogen
- 1910.104 - Oxygen
- 1910.110 - Liquefied Petroleum Gas (Including Propane)
- 29 CFR 1910.6 incorporates National Fire Protection Association (NFPA) 58, [Standard for the] *Storage and Handling of Liquefied Petroleum Gases*, as applicable to 1910.110.
- 29 CFR 1910.178, *Powered Industrial Trucks*, also incorporates NFPA 58 by 1910.178(f)(2).

- Compressed gases used as a propellant in non DOT cylinders or commonly referred to as "Aerosol Cans" are managed under MSC-RD-13299, *Hazard Communications* and MSC-PRO-10468 *Chemical Management* and as such are not considered in this RD.

NOTE: *NFPA 55,* Storage, Use and Handling of Compressed Liquefied Gases in Portable Cylinders, *is **not** incorporated by reference into OSHA 29 CFR 1910. It is also **not** included in the list of applicable fire codes in CGA P-1, Section 6.5. NFPA 55 does, however, contain significant information that is good business practice and also becomes mandatory by DOE O 420.1B,* Facility Safety.

The scope of this requirements document is also based to a minor extent on OSHA 29 CFR 1926 and OSHA 29 CFR 1910, Subpart Q, *Welding, Cutting and Brazing* but ***only*** the following sections:

- 1910.252(b)(4)(vi) - General requirements, Protection of Personnel, Working in Confined Spaces, Gas Cylinder Shutoff.

- 1910.253 – Oxygen-fuel gas welding and cutting.

- 1926.350 – Gas welding and cutting.

2.2 Fire extinguishers

Portable fire extinguishers, which frequently are/or involve compressed gas cylinders, are ***excluded*** from the scope of this requirements document. Information regarding the subject is found in 29 CFR 1910.157.

- NFPA 10, *Portable Fire Extinguishers*, also contains information on the subject.

2.3 Compressed Air

Compressed gas cylinders that are part of self-contained breathing apparatus (SCBA) units are ***excluded*** from the scope of this requirements document. Individual manufacturers provide information on the cylinders.

General compressed air cylinders used as part of supplied air respirator units (including SKA-PAK units) fall under the requirements of this document as it applies to the general high-pressure hazards and controls. Additional requirements, however, involved with breathing air are beyond the scope of this requirements document. Information on the subject is found in 29 CFR 1910.134, *Respiratory Protection*, and MSC-PRO-120, *Respiratory Protection Program*.

Breathing air cylinders (Compressed Air) are included in the CGA list of Oxidizing gases in CGA P-1, Appendix "C." This is ***not***, however, equivalent to, and is ***not*** to be confused with, an Oxidizer.

2.4 Chlorine cylinders

Chlorine Cylinders (in typical DOT class 3A or 3AA cylinders) are included in the scope of this requirements document to the extent that the precautions required for the safe handling and storage of any compressed gas cylinders must be followed. Additional controls, however, must be imposed which are beyond the scope of this requirements document. For example, according to CGA, chlorine cylinders must not be stored next to cylinders containing other compressed gases. One-ton cylinders are not included in the scope of this procedure. Additional information on the subject can be found in publications by the Chlorine Institute.

2.5 Air receivers/pressure vessels

General air receivers and pressure vessels are ***not*** within the scope of this requirements document.

2.6 Bulk compressed gas systems

Liquified Petroleum Gas (LPG) and Cryogenic Bulk gas systems are in the scope of this requirements document. Installation or modification of bulk compressed gas systems requires a permit from the site Fire Marshal.

More information regarding requirements for permitting is found in MSC-RD-8589, *Hanford Fire Marshal Permits*.

2.7 Procuring, Receiving, & Marking Cylinders

This requirements document does ***not*** cover procuring, receiving, or marking compressed gas cylinders.

Mission Support Alliance (MSA) handles all procurement, initial receiving, and inspection used by MSA operations to be sure cylinders are properly equipped and marked. Compressed gas cylinders used by subcontractors for use on MSA projects shall meet the DOT, OSHA, and CGA requirements criteria. Portable cylinders for compressed gas are constructed and maintained in accordance with DOT regulations (U.S. Department of Transportation, 49 CFR, parts 171-179). Cylinders are equipped with devices identified in OSHA 29 CFR 1910, Subpart H, and CGA publications incorporated into OSHA by reference.

2.8 Transporting Cylinders

After procurement, receiving, and inspection, cylinders are transported to individual facilities where the cylinders are stored, used, and handled as covered by this requirements document.

Transportation except as a part of normal on-site handling after receipt by individual facilities is ***excluded*** from the scope of this requirements document.

2.9 Filling Cylinders

This requirements document does ***not*** cover cylinder filling. SCBA and SKA-PAK cylinder refilling is performed exclusively by the Hanford Fire Department (HFD) using specific requirements and procedures. Other cylinders are filled by off site vendors. Contracts with those vendors impose the appropriate regulations and requirements for filling. Only those cylinders designed to be refilled can be refilled.

3.0 REQUIREMENTS

3.1 General safe handling requirements

NOTE: *For the tables in this section under the requirement "type" column, "V" means verbatim and, "I" means interpreted*.

#	REQUIREMENT	TYPE V or I	SOURCE
1.	Cylinders shall not be used as rollers, supports, or for any purpose other than to contain and use the original contents.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
2.	Cylinders shall not be dragged, struck, dropped, or rolled in the horizontal position, or allowed to violently strike each other or another surface.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
3.	A suitable hand truck, forklift truck, or similar handling device with the cylinder properly secured to the device shall be used when transporting cylinders.	I	29 CFR-1910.101; CGA P-1
4.	Cylinders shall be rolled only for short distances, using the curved bottom edge of the cylinder.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
5.	Cylinders shall not be lifted using the protective cap or with a magnet.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
6.	Ropes, chains, or slings shall not be used to suspend cylinders unless the cylinder has appropriate lifting attachments. When appropriate lifting attachments have not been provided, suitable cradles or platforms shall be used to hold the cylinder for lifting.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
7.	Cylinders shall not be stored at temperatures above 125 °F and shall be protected from temperature extremes.	I	29 CFR-1910.101; CGA P-1
8.	Cylinders shall be inspected prior to use. Inspection will include checking for dents, bulges, cracks, evidence of excess heat, etc. A cylinder shall not be used if damaged.	I	29 CFR-1910.101; CGA P-1
9.	Cylinder users shall ensure that all connecting devices are free of oil, grease, or other contaminants. Do not handle with oily/greasy hands or gloves.	I	29 CFR-1910.101; CGA P-1

10.	When valve protection caps or valve outlet caps and/or plugs are provided by the manufacturer, these items shall remain on the cylinder at all times except when the cylinder is secured and connected to dispensing equipment.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
11.	All gas cylinders shall be secured, whether in service or storage, to prevent falling. A suitable cylinder truck, train, or other steadying device shall be used to keep cylinders from being knocked over while in use. Propane gas cylinders used on Barbeque grills or other similar heating devices are designed to be stored or used without additional steadying devices.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
12.	When cylinders are transported by powered vehicles they shall be secured in a vertical position.	I	29 CFR-1926.350 CGA P-1
13.	No person other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by the owner shall refill a cylinder. No one shall use a cylinder's contents for purposes other than those intended by the supplier. All cylinders used shall meet the Department of Transportation requirements published in 49 CFR Part 178, Subpart C, Specifications for Cylinders.	I	29 CFR-1926.350 CGA P-1
14.	No damaged or defective cylinder shall be used.	I	29 CFR-1926.350 CGA P-1
15.	Equip gaseous hydrogen systems with pressure relief devices and protect from tampering. Arrange relief devices so that if activated, they have unobstructed upward vent path to open air.	I	CGA P-1

3.2 Training requirements

1.	Compressed gases shall be handled and used only by properly trained persons.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1

NOTE 1: *CGA P-1 defines "handling" as "Moving, connecting or disconnecting a compressed or liquefied gas container under normal conditions of use."*

NOTE 2: *MSC training course #020049, Compressed Gas Cylinder Safety, or equivalent, meets this requirement.*

3.3 Emergency response plan requirements

1.	An approved emergency response plan must cover compressed gas cylinders in the area.	I	29 CFR-1910.101; CGA P-1
2.	Only authorized personnel operating under an approved emergency response plan shall respond to an emergency involving compressed gas cylinders.	I	29 CFR-1910.101; CGA P-1

3.4 Storing cylinders - General requirements

1.	Compressed gases shall be stored and posted according to their hazard class (flammable, asphyxiant, etc.) or name of gas to be stored.	I	29 CFR-1910.101; CGA P-1
2.	Compressed gas cylinders shall not be stored with or near readily ignitable substances such as gasoline.	I	29 CFR-1910.101; CGA P-1
3.	Compressed gas cylinders containing flammable gases such as butane, propane, or acetylene shall be stored in well ventilated locations or ventilated cabinets.	I	29 CFR-1910.101; CGA P-1
4.	Storage areas shall be constructed so that they are dry, well ventilated, and made with noncombustible materials. Shelves must be able to support cylinders.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
5.	Noncombustible or limited-combustible construction shall be used (concrete/asphalt is the preferred building material) for the floors of storage areas.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
6.	Consideration shall be given to separating empty cylinders from full ones.	I	29 CFR-1910.101; CGA P-1
7.	Clear dry vegetation and combustible materials for a minimum distance of 4.6 meters (15 feet) from around the storage area.	I	29 CFR-1926.350; CGA P-1

NOTE: *It is suggested that all empty cylinders be marked "empty", unused cylinders "full", and those in service "In Use." All empty cylinders should be treated as if full. For example, empty cylinders that held oxidizing gases and flammable gases should not be stored together.*

8.	When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valve shall be closed and the protective cap put into place.	I	29 CFR-1926.350 29 CFR-1910.101; CGA P-1
9.	Prolonged exposure to the ground (earth) or to damp environment shall be avoided. Subsurface storage locations shall be avoided.	I	29 CFR-1910.101; CGA P-1
10.	Cylinders shall be protected from any object that will produce a harmful cut or other abrasion in the surface of the metal. Cylinders shall not be stored near elevators, walkways, unprotected platform edges, or in locations where heavy moving objects may strike or fall on them.	I	29 CFR-1910.101; CGA P-1
11.	"NO SMOKING" signs shall be posted at all flammable gas storage areas. Smoking is prohibited within 6 meters (20 feet) of flammable gas storage areas.	I	29 CFR-1910.101; CGA P-1

12.	Oxidizers shall be stored separately from flammable gas containers or combustible materials (especially oil or grease). A distance of 20 feet (6 meters) or a noncombustible barrier at least five feet high having a fire resistance rating of at least one-half hour is considered a minimum requirement.	I	29 CFR-1910.101; CGA P-1
13.	For requirements regarding specific gases such as acetylene, hydrogen, oxygen, or for toxic or corrosive gases, the Material Safety Data Sheets (MSDS) shall be consulted for appropriate guidance on the storage and compatibility requirements of the materials in question and/or the gas supplier shall be contacted.	I	29 CFR-1910.101; CGA P-1
14.	When using compressed gas for welding operations, additional requirements found in 29 CFR 1910.252(b)(4)(vi) and 1910.253 shall be met.	I	29 CFR-1910.101; CGA P-1; 29 CFR 1910.252 (b)(4)(vi) and 1910.253.
15.	Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while they are actually being hoisted or carried.	I	29 CFR-1926.350 CGA P-1
16.	For gas cylinders being stored for construction purposes, the supervisor or building manager inspects compressed gas cylinder storage areas at least semiannually and documents on form A-6004-303 or equal.	I	DOE O 420.1
17.	Transporting compressed gas cylinders in automobiles or in closed-bodied vehicles (per CGA P-1 section 3.9) should be discouraged. Shipping compartments shall be adequately ventilated.	I	29 CFR-1910.101; CGA P-1 CGA PS-7

NOTE: *Although general transportation is outside the scope of this requirements document, information on the subject can be found in DOE O 460.1A, Packaging and Transportation Safety, CRD. Additional information is found in* MSC-PRO-156, *Onsite Hazardous Material Shipments,* MSC-PRO-157, *Offsite Hazardous Material Shipments, and* MSC-PRO-158, *Shipping and Receiving in the 1100 Area.*

3.5 Placing Compressed Gas Cylinders

1.	Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. When this is impractical, fire resistant shields shall be provided.	I	29 CFR-1926.350 CGA P-1
2.	Cylinders shall be placed where they cannot become part of an electrical circuit. Electrodes shall not be struck against a cylinder to strike an arc.	I	29 CFR-1926.350 CGA P-1

3.	Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.	I	29 CFR-1926.350 CGA P-1
4.	Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.	I	29 CFR-1926.350 CGA P-1

3.6 Fuel Gas and Oxygen Manifolds

1.	Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it.	I	29 CFR-1926.350 CGA P-1
2.	Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within enclosed spaces.	I	29 CFR-1926.350 CGA P-1
3.	Manifold hose connections, including both ends of the supply hose that lead to the manifold, shall be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters shall not be used to permit the interchange of hose. Hose connections shall be kept free of grease and oil.	I	29 CFR-1926.350 CGA P-1
4.	When not in use, manifold and header hose connections shall be capped.	I	29 CFR-1926.350 CGA P-1
5.	Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.	I	29 CFR-1926.350 CGA P-1
6.	Ensure compressed gas manifolds are designed to meet NFPA Standard 51.	I	NFPA 51
7.	Ground and bond flammable-gas piping systems in accordance with NFPA Standard 51.	I	NFPA 51
8.	When acetylene or oxygen cylinders are connected by a manifold, approved flash arrestors are installed between each cylinder and the coupler block. One flash arrestor installed between the coupler block and regulator is acceptable only for outdoor use or if the number of cylinders coupled does not exceed 3. Ensure reverse-flow gas check valves are installed on both lines of all oxygen and fuel line setups.	I	CGA G-1

3.7 Bulk LPG systems

This section outlines requirements related to the operations and maintenance of bulk plant LP-Gas systems used for emergency power generation and pipeline LP-Gas systems such as at HAMMER.

#	REQUIREMENT	TYPE V or I	SOURCE
1.	Design, construction, and location of LPG containers, piping, and other components will comply with 29CFR1910.110.	I	10CFR851
2.	Operating Procedures *NOTE: Multiple containers in vapor service only, with individual water capacity not exceeding 1200 gal water with a maximum aggregate of 6000 gal shall not require written operations or maintenance procedures where they are not manifolded together.* Operating procedures shall address all aspects of LP-Gas transfer as appropriate including inspection of hoses, fittings, and connection and disconnection procedures. Operating procedures shall include operator actions to be taken if flammable concentrations of flammable liquids or gases are detected in the facility using fixed detectors, portable detectors, operating malfunctions or human senses. Operating procedures for vaporizers shall include maintenance of vaporizations rate, pressure control, and temperature. Procedures shall include specific actions to be taken when parameters exceed normal operating limits and criteria for emergency shutdown. Facilities shall prepare and maintain in a common location or locations written operation procedure manuals that contain operating procedures.	I	NFPA 58, 14.2.1
3.	Content of Operating Procedures Written procedures shall be the basis for conducting activities associated with the Propane system. Operating procedures shall be updated whenever a change occurs that affects the operation of a system and prior to its startup. The procedures shall address the following: General Operation Procedures • General procedures including emergency procedures, startup, operation and shutdown of transfer system and equipment. This includes the description, location, and operational guidelines for the fire systems and emergency equipment.	I	NFPA 58, 14.2.2

	• Combustible material buildup around system (i.e., tumbleweeds) • Sources of ignition. • Signage and markings. • Security and access. • Fire response. Loading and Unloading procedures • Hoses • Chocks • Fire extinguishers • Sources of ignition • Personnel • Security and access • Fire response		
4.	Maintenance Procedures Written maintenance procedures shall be the basis for maintaining the mechanical integrity of the LP gas system. ***NOTE:*** *Multiple containers in vapor service only, with individual water capacity not exceeding 1200 gal water with a maximum aggregate of 6000 gal shall not require written operations or maintenance procedures where they are not manifolded together.* • Procedures shall be updated whenever a change occurs that affects the maintenance of a system. • Persons who perform maintenance of the Hammer system shall be trained in the hazards of the system and in the maintenance and testing procedures applicable to the installation • Any maintenance contractor shall ensure that each contract maintenance employee is so trained or under the immediate supervision of such a trained person to perform the maintenance procedures. The maintenance procedures shall address the following: • Corrosion control o Exposed piping o Buried piping	I	NFPA 58, 14.3.1

	○ Cathodic protection ○ Atmospheric corrosion • Physical protection • Hoses • Piping appurtenances • Containers		
5.	Maintenance Manuals Maintenance manuals for all equipment at the facility shall be kept at the facility and shall be available to maintenance personnel. Maintenance manuals shall include routine inspections and PM procedures and schedules Maintenance records shall be retained for the life of the equipment	I	NFPA 58, 14.3.2
6.	Buried Bulk Propane Containers Cathodic protection shall be tested every 3 years per WAC-173-360-320	V	WAC-173-360-320

3.8 Cryogenic Gases

#	REQUIREMENT	TYPE V or I	SOURCE
1.	Cryogenic Gases/Fluids systems and components shall be designed, constructed and handled in accordance with NFPA 55 section 8.0	I	NFPA 55, 8.0
2.	Bulk Cryogenic fluid storage tanks shall be inspected by a State of Washington Inspector and a certificate issued every two years.	I	WAC-296-104-100

4.0 FORMS

A-6004-303, Gas Cylinder Storage Area Inspection Checklist

5.0 RECORD IDENTIFICATION

Documentation generated by this procedure (e.g., forms, data sheets, checklists) shall be submitted to Document Control in accordance with MSC-PRO-10588, *Records Management Process.*

Records Capture Table

Name of Document	Submittal Responsibility	Retention Responsibility
Gas Cylinder Storage Area Inspection Checklist	Project Management	Document Control

6.0 REFERENCES

6.1 Source References

29 CFR 1910, Subpart H (Hazardous Materials)
29 CFR 1910, Subpart Q (Welding, Cutting and Brazing)
29 CFR 1926.350 (Gas Welding and Cutting)

Compressed Gas Association (CGA) Pamphlet P-1 (2008 Issue), *Safe Handling of Compressed Gases in Containers*

Compressed Gas Association (CGA) Pamphlet G-1 (2009 Issue), *Acetylene*

Compressed Gas Association (CGA) Position Statement PS-7, *CGA Position Statement on the Safe Transportation of Cylinders in Passenger Vehicles*

NFPA 58, *Storage and Handling of Liquefied Petroleum Gases*
NFPA 55, *Compressed Gases and Cryogenic Fluids*
NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*

6.2 Working References

29 CFR 1910.134, Respiratory Protection
29 CFR 1910.157, Portable fire extinguishers
49 CFR, Transportation, Parts 171-179 (U.S. Department of Transportation)

DOE O 460.1C, Packaging and Transportation Safety, Contractor Requirements Document (CRD)
DOE O 420.1B (Supp Rev 4), Facility Safety

MSC-PRO-120, *Respiratory Protection Program*
MSC-PRO-156, *Onsite Hazardous Material Shipments*
MSC-PRO-157, *Offsite Hazardous Material Shipments*
MSC-PRO-158, *Shipping and Receiving in the 1100 Area*
MSC-PRO-10468, *Chemical Management*
MSC-RD-8589, *Hanford Fire Marshal Permits*
MSC-RD-13299, *Hazard Communications*
NFPA 10, Portable Fire Extinguishers